TENNIS RACQUET EQUIPPED WITH A TENNIS BALL RETRIEVER

Field of Invention

The present invention relates to a retrieving device and, more particularly, to a retrieving device for attachment upon a tennis racquet so as to retrieve tennis balls therewith.

Background of the Invention

The prior art provides a very interesting history of the arts' unsuccessful attempt to utilize Velcro®-type materials in combination with a tennis racquet to serve as a ball retriever. The purpose of such a retriever, when attached to the tennis racquet, would permit the tennis player to merely extend the tennis racquet to retrieve the tennis ball from the court. Early patents such as French *Patent No, 2,594,037* by Gene Muslin theorized that a cloth wrapper with hooks including catching elements made of smooth layers of fastening retention threads attached to a tennis racquet would allow the tennis player to retrieve the ball without bending down or stooping. The French patentee disclosed numerous positions for attaching the cloth with hooks to the tennis racquet. The French patentee fails, however, to provide any enabling guidance as to what type of cloth with hooks could be utilized for this purpose. The patent literature collectively reveals that the positioning and configuration of the retrieving element upon the racquet by the French patentee would not lend itself to effective grasping and retrieval of a grounded tennis ball.

Another early patent to Peter Ross (*U.S. Patent No. 3,874,666*) proposes the use of what is referred to as mid-temp Velcro®. Apparently, as indicated in the patent, the Ross retriever includes an outer surface equipped with stainless hooks which, when emplaced upon a tennis racquet, will hook onto the nap of a tennis ball. A subsequent patent, *U.S. Patent No, 4,834,393*, to Joseph A. Feldi in discussing the shortcoming of the Ross retriever indicated that the stainless steel hooks as taught by U.S. Patent No, 3,874,666 to Ross, had two major drawbacks. First, it was extremely difficult to pick up a tennis ball with the Ross system with success only in one out of five tries. The second problem was indicated that "after just a few retrievals using the standard tennis ball the ball covering becomes fuzzy and no longer useful in normal play." In

order to overcome this inability to effectively retrieve a tennis ball with a hooked material attached to the tennis racquet, Feldi proposed to completely alter the outer covering of the tennis ball to a nap consisting entirely of a different looped material more compatible with the hooks which, in turn, then would allow a hooked material of conventional Velcro®-type hooked fabric affixed to the end of tennis racquet to effectively pick up a tennis ball. Thus, Feldi's suggestion was change the tennis ball nap so that it could be retrieved with the conventional hooked fabric materials.

Another early patent to Steven M Schubert entitled "Racket Mounted Tennis Ball Retriever" of *U.S. Patent No. 4,210,327* makes reference to a tennis ball retriever sold under the trademark "GRAB-R" which consisted of an adhesive strip containing countless tiny hooks for adherence to the rounded frame at the head of the racquet. Schubert indicated that in order to permit the GRAB-R to retrieve the tennis ball, the tennis player must first secure the ball under the foot to keep if from scooting away and then engage the racquet retriever onto the ball and twist the racquet so as to snag the hooks into the covering pile.

Recognizing the inability for hooked fabric materials, such as Velcro® hooks, to effectively retrieve a tennis ball when attached to a flat or convex surface, the Schubert patentee, as well as many others, proposed to attach a cup-shaped retriever onto the butt end of the tennis racquet. The cup provided an internal cavity of a concave configuration conforming substantially to the configuration of the arcuate periphery of a tennis ball. By compressing the grounded tennis ball against the cup, an improved interlocking engagement of the hooked and curling looped fabrics was achieved by simply decompressing the tennis ball (i.e. lifting) which action apparently allowed the hooks and tennis pile to interlockingly intermesh onto one another. This design significantly increases the contacting surface of the hooks allowing the weak hooking efficacy of many hooks to provide sufficient attachment to lift the ball from the ground. Schubert indicates that if the fabric section is placed on the convex surface or even on a planer surface, which would be applied tangentially against the ball, the retriever would be ineffective for snagging the hooks into the piled loops of the ball and lifting the ball. Because of the

increased surface exposure by cupping the ball, the ineffective hooks are numberly increased so as to enable the hooks to snaggingly engage the curly pile of the ball so it may then be lifted from the ground. The proposal by Schubert is not the most desirable way for attaching a ball-retrieving device to a tennis racquet. The handle of the tennis racquet is normally held by the tennis player. Consequently, when it is desired to retrieve a ball, the tennis player must grasp the head of the tennis racquet and then force the handle butt end and attached the tennis ball retriever against the courted tennis ball.

A somewhat similar ball-retrieving apparatus is disclosed in *U.S. Patent No. 4,993,712* to Kenneth J. Urwin. Similar to the Schubert patent, the Urwin patentee relies upon a cup-shaped gripping section of an arcuate shape conforming to the spherical shape of a tennis ball, which enables the enlarged portion of the gripping hooks to more effectively contact, attach and securely grip the tennis ball.

Another early version of a ball retriever of a cup shape for attachment to the butt end of the tennis racquet handle may be found in *U.S. Patent No, 4,114,881* to David A. Norton. The Norton patent relies upon a concave recess equipped with clip means preferably formed from a resilient material, which includes a plurality of radially extending arms. The arms are turned so as to extend in a substantially parallel relationship to the sidewalls of the receiving cup for the tennis ball. The free ends of the arms include a plurality of hook means disposed in a nap-engaging relationship to the corresponding portions of the tennis ball. The hook means are generally disclosed as teeth. The patentee alternatively mentions, but does not show, that a strip of Velcro® tape could also be used.

In summary, the prior art generally teaches that Velcro®-type hooked materials (i.e. fabric hooks) of a polymeric material construction, such as a nylon, necessitate substantial interfacial contact with the tennis ball cover in order to effectively be utilized as a ball retriever. Consequently, the prior art has taught the utilization of cup-shaped attachments to the tennis racquet which generally conform to the configuration of the tennis ball so as to provide an increased concave surface area for more effectively hooking and retaining the tennis ball. Since

these cup-shaped retrieving devices are relatively bulky, they cannot be affixed to the tennis racquet head but must rather necessarily placed upon the butt end of the tennis racquet handle. The prior art consistently teaches that such hooked fabric materials are ineffective when utilized simply as a flat strip attached to the surface of the racquet rim or as an attachment upon the convex surface of the tennis racquet head. The prior art solution to the ineffectiveness of Velcro®-type fasteners is to increase the interfacing surface by designing the retriever to extensively cup the ball so that the ineffective hooks are then present in sufficient numbers to allow the ineffective hooks to lift the tennis ball.

In each of these situations, the prior art teaches that the tangential contact and use of such a retainer fails to provide a sufficient number of hooks so as to effectively grasp and retain the tennis ball. The applicant desired to utilize a hooked fabric attachment which could be removably attached to the flat or convex surfaces of the tennis racquet and allow for retrieval of the tennis ball simply by tangential contact of the tennis ball therewith. Unexpectedly, the applicant has discovered that a very narrow range of hooked fabric materials which, when attached to the tennis racquet, possess unexpectedly superior ball-retrieving efficacy notwithstanding making only tangential contact between the hooked material and the tennis ball nap. The discovery permits a lightweight, adhesively and removable ball retrieving element to be placed upon the tennis racquet head without adversely affecting the player's use of the racquet. The retriever is light in weight and does not alter the balance of the tennis racquet. When it is desired to retrieve a courted ball, the tennis player merely extends the retrieving head so as to tangentially contact the surface of the tennis ball with the retriever and tangentially hook onto the nap of the ball with the retrieving hooks and lift the tennis ball therewith The retrieving device exhibits extraordinary hooking and lifting efficacy. Simply tangential contact results in a surprisingly superior engagement efficacy upon initial contact with the tennis ball. The retrieving device has been effective upon all of the major brands of tennis balls.

Summary of the Invention

It has been discovered that a highly specialized hook type of fabric derived from hook and loop fasteners, when attached to a tennis racquet, will effectively tangentially hook and lift all major brands of tennis balls. Prior hooked fabric fasteners required substantial surface area contact with tennis ball pile in order to hook and lift a tennis ball. The specialized hooks uniquely penetrate the tennis ball nap or pile, effectively hook a sufficient number of pile threads and tenaciously retain the threads in a hooking relationship while the tennis ball is lifted off the ground. The tennis player merely detaches or unfastens the tennis ball from the hook fastener, thus eliminating the need to bend over and manually retrieve the ball from the ground.

Unlike the conventional cup-shaped tennis ball retrieving attachments, the unique hooked material may be adhesively attached to a shoulder of a tennis racquet and used to tangentially contact, lift a hooked tennis ball pile and the tennis ball from the ground. Almost all hooked materials of a hook and loop fastener combination will fail to possess this unique functionality. An industrial hook fastener strap sold and distributed by the 3M Company, St. Paul, MN under the Scotchmate$_{TM}$ brand, when attached to tennis racquet shoulders and used as a ball retriever, exhibits unexpectedly superior efficacy in retrieving grounded tennis balls. Unlike most other hooked fabric attachments typically of a cup shape, the present hooked fabrics, when attached to a shoulder, will hook and lift a tennis ball upon tangential contact.

Merely tangentially contacting the tennis ball pile with the hooked fabric permits all major brands of tennis balls to be retrieved from the ground. A particularly effective tennis racquet attachment contains thicker monofilament hooks (e.g. 8.5 mm diameter) pre-shrunk to provide dimensional stability and flatness so as to tenaciously retain the hooked fibrous pile of tennis ball and permit it to be lifted from the ground. The individual hooks of the fastener are further characterized as having an average hook depth deeper in depth than most fastener hooks (e.g. 0.71 mm vs. 0.61 mm or less) to permit deeper penetration of the hooks so as to more tenaciously retain fibrous pile hooked by the hooks. Similarly, the average hook width is wider (e.g. 1.13 mm) so as to allow more space for the pile fibers hooked by the hooks. The average

height of the hooks is also greater (e.g. 1.91 mm) than other hooks tested which reflects in more deeper penetration into the pile of tennis ball and greater quantum of fibrous pile to be potentially hooked and retained by the hooks. The hooked material also contains a sufficient number of individual hooks so as to effectively hook and lift all major brands of tennis balls.

Brief Description of the Drawings

Figure 1 depicts a tennis racquet in which a shoulder portion of the tennis racquet head is equipped with the tennis ball retriever attachments of this invention.

Figure 2A depicts a view of the ball retriever shown in Figure 1 being positioned for tangential contacting and hooking onto a tennis ball.

Figure 2B depicts tangentially hooking and lifting of the hooked tennis ball with the ball retriever illustrated in Figure 2A.

Figure 3 illustrates a view of a hook and loop fastener material which is used as a hook source for the attachments shown in the figures.

Figure 4 is a magnified cross-sectional view depicting a single row of hooks of the hooked fabric material illustrated in Figure 3 engaging the pile of a tennis ball.

Figure 5 is a magnified view depicting an isolated hook shown in Figure 4.

Figure 6 depicts an alternative positioning of the ball retriever attachments upon the head of the tennis racquet.

Figure 7 is an enlarged cross-sectional view taken along line 7-7 of Figure 6.

Detailed Description of the Invention

Pursuant to the present invention, there is provided a method for affixing a highly specific type of a hooked fabric material or attachment (generally referenced as a **30** series number) upon a flat or convex rimmed region or shoulder **11** of a head of a tennis racquet (generally referenced as **1**) so as to permit a tennis player **P** to retrieve a tennis ball **T** upon tangentially contacting the hooked material **30** onto the tennis ball **T**. Unlike previous tennis ball retrieving attachments to a tennis racquet which normally required a cup-type receiving fitted with Velcro®-type material, the present invention uniquely allows the tennis ball **T** to be retrieved simply by tangentially

contacting the nap **N** of the tennis ball **T** cover with a hooked fabric material **31** affixed to the flat or convex rimmed region **12** of a tennis racquet shoulder **11**. Similar to the frustrations encountered by prior researchers, the inventor also experienced the art-recognized shortcomings that Velcro® type of hooked fabric materials are relatively ineffective in engaging and hooking onto a tennis ball pile so as to permit its lifting therewith.

A tennis racquet **1** is generally comprised of a handle **2** for gripping the racquet **1**, a head **6** which includes an oval-shaped frame **7** from which lateral strings **8** are strung vertically and horizontally across the head **6**. A throat section **9** connects head **6** and frame **7** to handle **6**. The outer perimeter of frame **7** of head **6** extending clockwise from the eight o'clock to the four o'clock position (handle **2** referenced at twelve o'clock) is referred to as the shoulder region **11** of the tennis racquet **1**. The outwardly convex surface region **12** of shoulder **11** serves as the mounting site for the retrieving attachment **30** of this invention.

Unexpectedly, it was discovered that amongst the host of hooked fabric materials commercially available, there exists a highly select grouping of hooked fabric materials of uniquely different characteristics which permit a tennis ball **T** to be retrieved by tangential contact onto the tennis ball piled cover **N**. The discovery allows the hooked ball retriever material to be adhesively affixed upon the racquet in a position which is most effective for the tennis player's **P** use. Unlike the prior art teachings of placing a retrieving cup at the butt end of the handle, the present invention permits the hooked material **30** to be adhesively applied to the upper half section (preferably about the shoulder rim) of a tennis racquet head. Typically the hooked material **30** as supplied by the manufacturer is equipped with an adhesive backing **33** protectively covered with a removable plastic strip $\mathbf{P_c}$ which, when removed, permits the hooked material **30** to be affixed to a rimmed shoulder **12** of the tennis head **6** as illustrated in Figures 1, 2A, 2B, 6 and 7. If desired, the removable hooked material **30** may be subsequently removed from shoulder **11** so as to permit restringing or other maintenance of racquet **1**.

Figure 3 illustrates a Scotchmate$_{TM}$ industrial fastener SJ3526, a hook and loop industrial fastener comprised of a loop fabric material **L** supported by an adhesive backing $\mathbf{A_b}$ with a

plastic cover $\mathbf{P_c}$ which, when peeled or stripped from the adhesive backing, exposes the adhesive backing member, all of which is described and not used herein. Opposite the looped material **L** there is illustrated in Figure 3 a hooked nylon fabric material **30** comprised of a series of spiral nylon hooks **31** supported by fabric backing **32** and an adhesive coating **33** on an opposite side to secure the hooked nylon fabric material **30** to a shoulder region **11** of a tennis racquet **11**. The adhesive backing **33** is similarly protected by a strippable plastic strip $\mathbf{P_c}$.

The preferred positioning of the hooked material **30** upon the tennis racquet **1** along the peripheral shoulder **11** margin of the racquet rim **12** is illustrated by Figures 1 and 6. The preferred positioning would correspond to an arc extending from the nine o'clock position to the three o'clock position relatively to the located handle **2** at a six o'clock position. The adhesively backed hooked material **30** may be emplaced entirely about the outer periphery of the racquet head **6** or partially at positions between the nine o'clock and three o'clock positioning. Although the adhesive backing **33** may be placed forwardly and rearwardly upon the flat surfaces of the shoulder **11**, the hooked material **30** is placed upon a peripheral convex part of the rim **12** as shown in Figures 1, 2A, 2B, 6 and 7. The most preferred positioning for tangentially contacting of the ball with the tennis racquet is between ten o'clock and 2 o'clock positions.

In general, the hooked material **30** useful in this invention is derived from pre-shrunken nylon monofilaments so as to impart sufficient rigidity to the individual hooks to permit the hooks to penetrate the pile **N**, hook the pile loops **N**, and retain sufficient rigidity to maintain the hooks **31** in a hooking position and lift the tennis ball **T**. In general, the effective hooked materials **30** utilized herein are constructed of monofilament nylon hook **31** as depicted in Figure 5 and characterized as having a diameter **d** substantially larger than most hooked fabric materials. In addition, the individual hooks **31** of the hooked material **30** will generally have an average height higher in height **h** than those which do not work in the invention. In addition, the average width **w** of the individual hooks **31** will be generally wider in width than those which do not work. In addition, the hook depth $\mathbf{H_d}$ is also generally deeper in comparison to those Velcro® brand hooked fastener strips which fail to possess the necessary properties in order to retrieve a

tennis ball upon tangential contact therewith. It has, accordingly, been unexpectedly discovered that fastener strips comprised of fabric hooked materials **30** characterized as being of significantly greater diameter **d**, height **h**, width **w** and depth $\mathbf{H_d}$ will allow for the tennis ball retriever **30** of this invention to retrieve a tennis ball **T** simply upon tangential contact therewith as illustrates by Figure 2B and 4.

With particular reference to Figures 4 and 5, the average diameter of the pre-shrunken monofilament hooks utilized herein, it has been found that an average diameter **d** of greater than 8.0 mil (0.008 inch), preferably at least 8.25 mil, and most preferably of at least 8.5 mil is needed in order to provide sufficient hook tenacity to retain hook **31** integrity and hold the tennis ball after hooking and during lifting. It has been found that those hooked materials **30** having hooks of an average height **h** less than 1.65 mm are ineffective, while those of at least 1.70 mm and advantageously greater than 1.80 mm exhibit more enhanced hooking characteristics for use herein. Particularly effective results are achieved with those hooked materials **30** having an average hook height **h** of at least 1.85 mm and preferably of about 1.90 mm or higher. The height of the hook in combination with thicker diameter apparently allows the hook to more deeply penetrate the pile **N** and more effectively hook more deeply than most conventional types of hooked materials.

The hook width **w** appears to also play an instrumental role in the efficacy of the hooked materials **31** herein. The wider hook dimension **w** in cooperative combination with the hook height **h** and diameter **d** apparently permits more individual fibers of the ball pile **N** to be hooked and lifted by the retrieving attachment **30** herein. The average width **w** of the individual hooks will advantageously be greater than about 1.0 mm and preferably greater than 1.05 mm with the average hooks having a hook width **w** ranging from about 1.1 mm to about 1.3 mm and being particularly adaptable herein.

As mentioned, the average depth $\mathbf{H_d}$ of the hooked materials **30** used herein is deeper than most other materials. In general the depth $\mathbf{H_d}$ of the hooks will typically be greater than 0.55 mm and preferably greater than 0.60 mm with an average hook depth ranging from about

0.65 mm to 0.75 mm being particularly utilizable for those purposes herein. The hook depth $\mathbf{H_d}$ coupled with the hook diameter **d** plus the benefits of hook height **h** and width **w** affords apparently a more tenacious hook **31**, making it difficult to dislodge the hooked pile **N** from the individual hooks **31**.

The number of hooks **31** per square inch is not as critical to the efficacy of the material **30** as are the individual hook **31** characteristics. For example, it has been discovered that materials having more hooks per square inch do not necessarily outperform a hooked material of a lesser density, but embodied the preferred hook characteristic of the materials as described above. In general, the hooked materials used herein will typically contain more than 250 hooks per square inch and preferably of at least 300 hooks per square inch.

Example

After it was unexpectedly discovered that a particular hooked material of a "hook and loop" fabric fastener exhibited unexpectedly superior efficacy of lifting a tennis ball upon tangential contact, a series of tests and studies were then undertaken to ascertain the efficacy of other hooked materials for this purpose. A comprehensive study was undertaken to ascertain the chemical and physical attributes contributing to this unusual phenomenon. A host of different types of hooked materials were adhesively placed to the outside rail of tennis racquet. Except for an unusual hooked material (not normally available at retail outlets), all of the hooked materials failed to exhibit any efficacy in lifting a tennis ball after tangential contact of the material with the tennis ball. After numerous failures, six different types of commercial "hook and loop" and "molded" fasteners representative of various different types of hooked materials were chosen for the test. The test included a hooked material which exhibited a lesser efficacy than the superior performer in tangentially hooking onto the nap of a tennis ball and raising the hooked ball from the ground. Weighted tests were conducted as part of this study so as to compare the efficacy between different types of hooked materials. Microscopic examinations were also conducted upon those hooked materials exhibiting a tendency to hook the nap, albeit insufficient to

effectively retrieve a courted tennis ball. For test purposes, a hooked material exhibiting no hooking and lifting efficacy was included in the study.

Six types of commercial "hook and loop" and "molded" fasteners were ultimately tested to determine their ability to tangentially attach to and lift tennis balls off the ground under normal playing conditions. A six-inch strip of each type of fastener was attached to the edge of a tennis racquet head with its adhesive backing and attempts were made to retrieve various types of new balls. The types of fasteners tested in this example were as follows:

- Scotchmate$_{TM}$ brand industrial fastener strip manufactured by 3M Company, St. Paul, Minnesota and obtained from the 3M manufacturing plant in Fairmont, Minnesota. Specifications: 8.5 mil diameter nylon monofilament hooks at a density of over 300 per square inch. Pre-shrunk to provide dimensional stability and flatness. Hook dimensions: mean height - 1.91 mm, mean width - 1.13 mm, mean hook depth - 0.71 mm.

- Velcro® brand hook and loop fastener strip, type "Hook 88". Distributed by H&L Products, Inc. and purchased at Sherman Way Car Wash, Los Angeles, California. Specifications: 8.0 mil diameter nylon monofilament hooks at a density of over 300 per square inch. Hook dimensions: mean height - 1.67 mm, mean width - 1.01 mm, mean hook depth - 0.51 mm.

- Velcro® brand hook and loop fastener strips, type "Hook 65". Obtained from Rubenstein and Ziff, Inc., Minneapolis, Minnesota. Specifications: 6.5 mil diameter nylon monofilament hooks at a density of over 400 per square inch. Hook dimensions: mean height - 1.37 mm, mean width - 0.95 mm, mean hook depth - 0.61 mm.

- Velcro® brand fastener strips, type purchased at Menards stores, La Crosse, Wisconsin and manufactured by Velcro USA, Inc., Manchester, NH. Specifications: unknown, except for hooks at a density of over 300 per square inch.

- Velcro® brand fastener, type "MVA #8" bulk material purchased at Ace Hardware, La Crosse, Wisconsin. Manufactured by Velcro USA, Inc., Manchester, NH. Specifications: molded ARROWHEAD nylon hook tape with 180 hook elements per square inch.

- Helping Hand PRESS-TO-LOCK adhesive strips manufactured by The Faucet Queens, Inc., Vernon Hills, Illinois and purchased at Fleet Farm stores in Winona, Minnesota. Specifications: nylon hooks of unknown diameter and density.

Three types of major brand name tennis balls were used in the above tests:

- Wilson Championship, manufactured by Wilson Sporting Goods Co., Chicago, Illinois
- Dunlop Tournament, manufactured by Dunlop Sports, Greenville, South Carolina
- Penn Medalist, manufactured by Penn Racquet Sports, Phoenix, Arizona.

Each of the six types of fastener strips listed above were tested to determine if they were capable of picking up tennis balls in at least two out of three consecutive attempts. Each type of fastener was tested on all three types of balls listed above, in triplicate (three separate attempts, each on a different ball). If a certain type of fastener worked, it was then further tested in triplicate to determine what amount of additional weight the retrieving strip could pick up. This was done by cutting a 2 cm. slit in each test ball and inserting pennies through the slot into the interior of the ball. Pennies were continually added and tested until the retrieving strip failed to pick up the ball two out of three times.

After each ball was tested, the coins were removed and weighed to determine the "additional weight failure" for each ball (see Table 1 attached). The raw weight of each ball was also measured and recorded so a "total pick-up weight" (see Table 1 attached) could be calculated for each ball. All weights were measured on a calibrated "Ohaus" portable electronic balance (S.N. 23365).

The following Table 1 tabulates the comparative efficacy of the ScotchmateTM and Velcro® "Hook 88" hook and loop fasteners in hooking and lifting three different kinds of commercially available tennis balls.

TABLE 1

Determination of the weights that Scotchmate™ and Velcro® "Hook 88" hook and loop fasteners can pick up when attached to the edge of a tennis racquet and a tennis ball is used as the loop material.

Note: Weight pick-up ability was measured by adding weight to a tennis ball until the ball could not be picked up 2 out of 3 attempts.

	Tennis Ball Weight	Additional Weight to Failure		Total Pick-Up Weight	
Ball ID	(grams)	Scotchmate (grams)	Velcro Hook #88 (grams)	Scotchmate (grams)	Velcro Hook#88 (grams)
Dunlop 1	56.24	274.57	66.58	330.81	122.82
Dunlop 2	56.69	300.98	94.62	357.67	151.31
Dunlop 3	57.03	305.96	63.53	362.99	120.56
Average	56.65	293.84	74.91	350.49	131.56
Std. Dev.				17.25	17.14
Wilson 1	56.18	294.49	46.66	350.67	102.84
Wilson 2	56.00	320.02	55.28	376.02	111.28
Wilson 3	57.63	292.95	41.05	350.58	98.68
Average	56.60	302.49	47.66	359.09	104.27
Std. Dev.				14.66	6.42
Penn 1	55.34	287.97	49.08	343.31	104.42
Penn 2	55.14	299.46	74.61	354.60	129.75
Penn 3	56.33	66.53	0.00	121.86	56.33
Average	55.60	217.99	41.23	273.26	96.83
Std. Dev.				131.23	37.29

The following Table 2 tabulates a statistical comparison of the total hooking and lifting weights for the two tested hook and loop fasteners.

TABLE 2

Statistical comparison of Total Pick-Up Weights for Scotchmate™ vs. Velcro® brand "Hook #88"

Dunlop (Scotchmate vs. Velcro) t-Test: Paired Two Sample for Means

	Var. 1	Var. 2
Mean	350.49	131.5633
Variance	297.55	293.725
Observations	3	3
Pearson Corr.	0.29818	
Hypothesized Mean D	0	
df	2	
t Stat	18.6145	
P(T<=t) one-tail	**0.001437****	
t Critical one-tail	2.919987	
P(T<=t) two-tail	0.002874	
t Critical two-tail	4.302656	

Wilson (Scotchmate vs. Velcro) t-Test: Paired Two Sample for Means

	Var. 1	Var. 2
Mean	359.09	104.2667
variance	214.97	41.216
Observations	3	3
Pearson Corr.	0.9470	
Hypothesized Mean D	0	
df	2	
t Stat	50.000818	
P(T<=t) one-tail	**0.0002****	
t Critical one-tail	2.919987	
P(T<=t) two-tail	0.0004	
t Critical two-tail	4.302656	

Penn (Scotchmate vs. Velcro) t-Test: Paired Two Samples for Means

	Var. 1	Var. 2
Mean	272.256	96.8333
Variance	17222.5	1390.79
Observations	3	3
Pearson Corr.	0.95430	
Hypothesized Mean D	0	
df	2	
t Stat	3.1733897	
P(T<=t) one-tail	**0.0432984****	
t Critical one-tail	2.9199873	
P(T<=t) two-tail	0.0865968	
t Critical two-tail	4.3026557	

Note: **P values less than 0.05 indicate a statistically significant difference between Scotchmate and Velcro Hook #88 performance.

A microscope examinations to determine the dimensions of various individual hooks of the hooked materials used in this example were also conducted. The microscopic examination included, for comparison purposes, a fastener strip that failed to pick up the balls. The hook "height", "width" and "depth" as illustrated in Figure 5 determinations were made for each type of fastener strip by measuring the dimensions of ten randomly selected hooks under a "Reichert" variable power dissecting microscope. A "Mitutogo" digital micrometer was used to make each measurement (S.N. 0051103). The results of this examination are tabulated in the following Table 3.

TABLE 3

Hook dimensions (mm) for ScotchmateTM and Velcro® brand Hook #88 and #65 fastener strips

	Scotchmate™			Velcro® Hook #88			Velcro® Hook #65		
	Height	Width	Depth	Height	Width	Depth	Height	Width	Depth
	1.78	1.14	0.81	1.76	1.00	0.59	1.50	0.98	0.44
	1.80	0.95	0.58	1.46	1.07	0.44	1.46	1.11	0.38
	1.85	1.15	0.94	1.71	1.07	0.40	1.33	1.10	0.59
	1.86	1.11	0.60	1.67	1.06	0.44	1.36	0.85	0.57
	1.88	1.03	0.62	1.65	1.06	0.43	1.24	0.93	0.57
	1.94	1.26	0.59	1.82	1.04	0.56	1.40	0.94	0.71
	1.95	1.27	0.50	1.64	0.92	0.51	1.38	0.89	0.65
	1.99	1.20	0.57	1.60	0.82	0.58	1.40	0.91	0.79
	2.00	1.08	0.88	1.69	1.08	0.60	1.29	0.82	0.81
	2.01	1.06	0.97	1.70	1.00	0.55	1.31	0.94	0.59
Avg.	**1.91**	**1.13**	**0.71**	**1.67**	**1.01**	**0.51**	**1.37**	**0.95**	**0.61**
S.D.	0.08	0.10	0.17	0.10	0.08	0.08	0.08	0.10	0.14

Results

As may be observed from Tables 1 and 2, only two types of fastening hooked strips exhibited a capacity to pick up tennis balls. These fastening strips were: (1) the Scotchmate$_{TM}$ brand industrial fastener manufactured by 3M Company and (2) the Velcro® brand, "Hook #88" fastener strips distributed by H&L Products, Inc. and purchased at Sherman Way Car Wash, Los Angeles, California. Only the Scotchmate$_{TM}$ Industrial Fastener was capable of consistently hooking and lifting all major tennis ball brands. Additional tests were then conducted to determine the amount of additional weight each type of fastener could pick up and if one type was superior to the other. In these efficacy tests, the Scotchmate$_{TM}$ brand industrial fastener manufactured by 3M Company was clearly shown to be superior to the Velcro® Hook #88

fastener strips tested (see Table 1 attached). The Scotchmate$_{TM}$ fastener not only consistently picked up approximately three times as much weight on average as the Velcro® Hook #88, but also did so consistently with minimal failures. The Velcro® Hook #88 fastener often was found to hook and lift in only two out of three attempts, and completely failed to hook and lift the Penn ball.

Pick-up weight data for the two fasteners was analyzed statistically with a "paired *t*-Test for comparing two sample means" to determine if there was a significant difference in the ability of each fastener to pick up weighted balls (see Table 2 above). Data was analyzed separately for each of the three types of balls tested. These statistical tests showed that the Scotchmate$_{TM}$ brand industrial fastener strip was capable of picking up significantly more weight than the Velcro® Hook #88 fastener when tested upon all three of the major brands of tennis balls.

Measurements to determine the average hook height, width and depth (see Figure 5 and Table 3 for data) of three types of fasteners (Scotchmate$_{TM}$, Velcro® Hook #88, and Velcro® Hook #65) revealed physical differences which singularly and collectively contribute to unexpectedly superior efficacy to hook and lift tennis balls. The Scotchmate$_{TM}$ industrial fastener strip was comprised of hooks with significantly greater height, width, and depth than the Velcro® Hook #88 or Hook #65 fastener strips tested (see Table 3). The average hook height, width and depth calculated for the Scotchmate$_{TM}$ fastener strip tested was 1.91, 1.13 and 0.71 mm., respectively. The average hook height, depth and width calculated for the Velcro® Hook #88 fastener strip tested was 1.67, 1.01, and .051 mm, respectively. The average hook height, width and depth calculated for the Velcro® Hook #65 fastener strip tested was 1.37, .095 and 0.61 mm, respectively. The average diameter of the hooks for the Scotchmate$_{TM}$ industrial fastener was also larger and more tenacious in retaining its hooking characteristics over other tested brands.

The Scotchmate$_{TM}$ brand industrial fastener strip was clearly superior to all the types of Velcro® brand hook and loop and molded fastener strips tested in its ability to consistently pick up three types of popular tennis balls when a strip of each material was attached to the edge of a

typical tennis racquet. The Scotchmate$_{TM}$ brand industrial fastener strips have unique physical characteristics which enable them to stick to and pick up tennis balls (weighted or not) when other fastener strips cannot. Collectively, the larger diameter (and thereby probably more rigid hook material (8.5 mil), longer hooks (1.91 mm), wider hooks (1.13 mm), deeper hooks (0.71 mm), and the pre-shrinking process used in its manufacture contribute to this unexpectedly superior efficacy.

The Scotchmate$_{TM}$ industrial fastener is uniquely distinctive in its ability to tangentially hook and lift the Penn tennis ball. The Scotchmate$_{TM}$ industrial fastener is available with some hooks in three different pressure-sensitive adhesive numbers, namely SJ3526, SJ3519 and SJ3572. The pressure-sensitive adhesive backing of SJ3526 exhibited excellent adherence to tennis racquet heads of different materials of construction while also affording removability to allow for restringing or other maintenance to the head.